

Claims 1-20 have been rejected under 35 USC 103(a) as being unpatentable over DiLeo et al. in view of Mikuni et al. (US Patent No. 5,175,337) and further in view of either Nishino et al. (US Patent No. 5,739,205) or Litke (US Patent No. 4,533,422).

Claims 1-20 have further been rejected 35 USC 103(a) as being upatentable over DiLeo et al in view of either Nishino et al. (US Patent No. 5,739,205) or Litke (US Patent No. 4,533,422) and O'Sullivan et al. (US Patent No. 3,832,334).

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Claims 21-42 and 40-44 have been rejected under 35 USC 103(a) as being unpatentable over DiLeo et al. (US Patent No. 4,209,358) in view of Burnett et al. (US Patent No. 2,628,178) and Gruber et al (US Patent No. 3,987,019).

In response to 35 USC §103 rejections the claims have been amended. In addition, the Examiner is asked to consider the arguments to follow.

Summary of the Invention

The pending claims are directed to a "method for packaging a semiconductor die to form a semiconductor package". The method includes the step of "providing a leadframe configured for wire bonding to the die". The method also includes the step of "providing a cyanoacrylate adhesive material formulated to cure in less than about 60 seconds at a temperature of about 20°C to 30°C and at an ambient atmosphere". The adhesive material is initially applied to the die 10 (Figure 1A) or to the leadframe 14 (Figure 1A). For a leadframe 14 having a mounting paddle 12 (Figure 1B) the adhesive material can be applied to the mounting paddle 12. For a lead-on-chip leadframe 14A (Figure 5), the adhesive material can be applied to leadfingers 38

(Figure 5), that are configured to support the die 10A (Figure 5).

Following the adhesive "applying" step, a "placing" step is performed wherein the die is placed "on the leadframe with the adhesive material in contact with the die, and the leadframe to form an adhesive layer therebetween". The adhesive layer 20 (Figure 1B) is then subjected to a "curing" step "at the temperature and at the ambient atmosphere in less than 60 seconds to bond the die to the leadframe". Following the curing step, a "wire bonding" step and an "encapsulating" step are performed.

The method of the invention can also be performed with an "anaerobic acrylic adhesive" rather than a "cyanoacrylate adhesive" (page 9, lines 9-16 of the specification). Independent claims 21 and 42 define the method with an "anaerobic acrylic adhesive".

Argument

MPEP 2142, 2143 set forth the three basic criteria for establishing a prima facie case of obviousness under 35 USC §103(a). First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success in obtaining the claimed invention based upon the references relied upon by the Examiner. Third, the prior art reference (or references when combined) must teach or suggest all the claim limitations.

With respect to the 35 USC §103 rejections, Applicants respectfully submit that the above criteria are not met by the cited combination of DiLeo et al. in view of either Nishino et al. or Litke, by the cited combination of DiLeo et al. in view of Mikune et al., Nishino et al. or Litke, by the cited combination of DiLeo et al. in view of either Nishino et al. or Litke and Sullivan et al., or by the cited

combination of Mikune et al., Nishino et al. or Litke and Sullivan et al.

In support of the 35 USC §103 rejections the Office Action states:

"applicants piecemeal attack on the references individually cannot establish unobviousness, since these rejections are based on a combination of references In re Mapelsden 141 USPQ 30) i.e. these rejections are not overcome by pointing out that one reference does not contain a particular teaching when the reliance for that teaching was another reference (In re Lyons 150 USPQ 741)".

In response to this statement it is submitted that Applicants have not attacked any of the prior art references. However, the references do not teach or suggest all of the claim limitations presently claimed such that the third element of the MPEP criteria for establishing obviousness have not been met.

A first feature not taught or suggested by the references is that the present claims are directed to a "method for packaging a semiconductor die to form a semiconductor package". As recited in the amended claims the package includes a die, and a "lead frame configured for wire bonding to the die". In addition, the amended independent claims recite a "wire bonding" step and an "encapsulating" step. Antecedent basis for the additional recitations is contained on page 4, lines 34-36 of the specification. In addition, the wire bonds 15 and encapsulant 19 are shown in Figure 1B.

In a semiconductor packaging process as presently claimed, an instant curing "cyanoacrylate" or "anaerobic acrylic" adhesive produces less stress between the die and the lead frame than with a conventional heat curing die attach process. Consequently, the wire bonds 15 and the encapsulant 19 have less stress, and an improved package 17 is provided. For example, with reduced stress, package bowing and wire bond separation are less likely to occur.

Such a room temperature die attach method for the present types of semiconductor packages is not taught or suggested by the prior art. For example, the primary reference, DiLeo et al., is directed to a "method of fabricating a microelectronic device". The method attaches a "light emitting diode 10", rather than a "semiconductor die" to a leadframe 20. In this regard the Office Action states:

"the electronic assembly of DiLeo et al is held/seen to indeed constitute a package of the type/in the manner envisioned by applicants (ie N.B. page 2 lines 10-11 of applicants specification)"

However, the amended claims are submitted to patentably distinguish the present method from the electronic assembly method of DiLeo et al. Specifically, wire bonding and encapsulating steps are not performed in combination with a room temperature die attach step in DiLeo et al. Further, the improved function of the adhesive layer in reducing stress in this type of package is not taught by the prior art, such that there is no motivation to use a room temperature curing adhesive in the present packaging method.

Amended independent claims 6 and 42 also state that the lead frame comprises "a plurality of lead fingers configured to support the die" (antecedent basis on page 10, lines 24-25 of the specification). This is the lead-on-chip configuration shown in Figures 5 and 6. Again because of less stress produced by the room temperature die attach step, the subsequent encapsulating step is improved.

In addition, amended independent claims 6 and 42 recite the step of "providing a filler in the adhesive material selected to improve dielectric strength, of the adhesive material in the package" (antecedent basis on page 5, lines 9-12 of the specification). Amended independent claim 12 states that the filler is "configured to increase a dielectric strength of the adhesive material to inhibit cross talk between the lead fingers in the package".

In contrast, DiLeo et al. teaches away from using any type of filler (column 2, lines 34-43). In this regard the Office Action states:

"while the improvement of these patentees resides in the non-use/elimination of any conduction/metallic filler material in the room temperature curing adhesive they may employ, there is no apparent/caveat made by them against the use of other (inorganic or even organic filler material)"

Additionally, Nishino et al. and Litke were cited as teaching the incorporation of a filler in a cyanoacrylate adhesive. Gruber et al. was cited as teaching the incorporation of a filler in an acrylate based anaerobic adhesive. Mikuni et al. and O'Sullivan were cited as teaching cyanoacrylate adhesive compositions.

However, the above MPEP criteria states there must be some motivation to modify the reference to establish obviousness. If DiLeo et al. specifically states that fillers shouldn't be used, one skilled in the art would be unlikely to modify the teaching of DiLeo et al. by incorporation of a filler.

Further, in formulating an obviousness rejection, the Examiner has the benefit of the present disclosure in picking and choosing references that anticipate various features of the claimed method. However, obviousness is to be assessed from the viewpoint of "one skilled in the art at the time of the invention" (35 USC §103). In addition, as the Examiner has urged the Applicants to consider the references together rather than piecemeal, Applicants would urge the Examiner to assess unobviousness by taking the invention "as a whole" (35 USC §103). In this regard Applicants would urge the Examiner to consider the present steps in combination, and to also consider the beneficial results of this combination of steps, in assessing unobviousness.

Also, in amended claims 6, 12 and 42 the filler is stated "to improve dielectric strength" or "to reduce cross talk" in the completed package. These concepts are

completely foreign to DiLeo et al., and are not contained in the cited art, such that the proposed modification is unlikely, and the first and third elements of the MPEP criteria for establishing obviousness have not been met.

In this regard, the Office Action justifies the motivation for the stated combination of references by stating:

"motivation to those of ordinary skill in this art is held/seen to be present in/provided for by these references themselves".

This statement is respectfully submitted to be in error. The present claims are in the art of "semiconductor packaging". None of the 35 USC §103 references are in the art of semiconductor packaging, and only the DiLeo et al. reference is in the electronics art. As argued above, DiLeo et al. does not suggest the presently claimed package, or packaging method, and teaches away from the use of fillers as presently claimed.

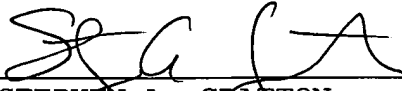
Admittedly, the remaining references teach that room temperature curing adhesive with fillers are known in the art. However, Applicants are not trying to patent room temperature curing adhesives, but rather their use in a semiconductor packaging process. Accordingly, Applicants would refute that statement that the references themselves contain the motivation for making the proposed combination. In addition, Applicants would submit that without such motivation, element 1 of the above criteria is not met, and the obviousness rejections based on the cited combination are improper.

Conclusion

In view of the amendments and arguments, favorable consideration and allowance of amended claims 1-22, and 40-44 is requested. Should any issues remain, the Examiner is asked to contact the undersigned by telephone.

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